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Significance of AM fungi in revegetation process in N-limited degraded ecosystems

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Arbuscular mycorrhiza (AM) is a sophisticated symbiotic system composed of AM fungi and plant roots. It is well documented that AM fungi absorb P from soil and supply P to host plant in exchange for C from plants. Currently it is recognized that AM fungi also absorb N from soil and supply it to plants. In contrast to P, mineral N in soil is not adsorbed with soil particles and moves with mass flow of water. Therefore, N supply through AM fungi may not much increase plant growth under usual arable conditions.

First, we examine if AM fungi can enhance plant growth through their N supply to plant using a model system. Secondly, the significance of AM fungi in N-limited degraded soils is discussed with emphasis on revegetation process.

We used a split compartment system composed of root and hyphal compartments (Tanaka and Yano 2005). In the system, the compartments were separated with fine nylon mesh and air gap so that neither mineral nitrogen moved nor roots elongated across the mesh. A seedling of Welsh onion (*Allium fistulos*) was transplanted and inoculated with *Glomus* sp. R10 in the root compartment (RC). After transplanting, ^{15}N labeled ammonium nitrate was added to either hyphal compartment (HC) or RC. “N addition to HC” treatment increased plant dry weight, shoot N and root ^{15}N concentrations, and P uptake. These indicate that, when movement of soil mineral N to plant roots is limited, AM fungi can enhance plant growth by supplying N to plant.

Secondly, we investigated how AM fungi were functioning through primary development of vegetation occurring in the lahar (mud flow of volcanic deposit) area of Mt. Pinatubo, Philippines (Oba et al. 2004). Because the lahar is comprised of newly erupted volcanic materials, it contains little organic matter and nutrients available for plants. Most of the area was sparsely vegetated with only a few gramineous plants, especially *Saccharum spontaneum*. However, some densely vegetated areas could be found in patch. These patches were characterized by coexistence of the gramineous plants and leguminous plants such as *Calopogonium muconoides* and *Centrosema pubescens*, which were well nodulated. Growth of the gramineous plants in these patches was greatly favored. In both less and densely vegetated areas, high density of arbuscular mycorrhizal (AM) fungal spores were found. *S. spontaneum* was slightly colonized with AM fungi while the leguminous plants were highly colonized. AM inoculation experiment carried out in the laboratory involving these gramineous plants showed that these plants were not highly mycorrhiza-dependent, and that some of them responded to added N only when these were mycorrhizal. These suggest that AM fungi might help their host plants to acquire N efficiently in N-limited soil environments.

References

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